

PATENT ABSTRACTS OF JAPAN

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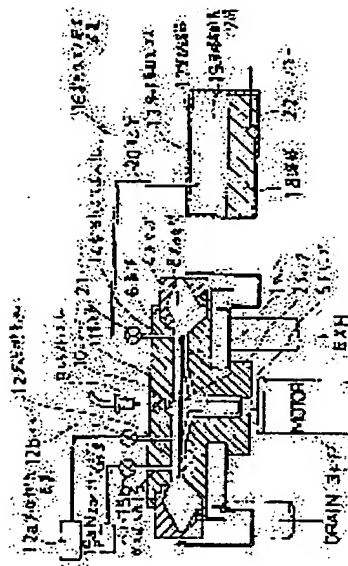
(72)Inventor : USHIJIMA MITSURU

(54) APPLICATION OF RESIST

(57)Abstract:

PURPOSE: To enable a uniform coating film to be formed by reducing pressure and discharging air at a coating area formed by a sealed container, filling a uniform-concentration media environment gas evenly, and then spin-coating it.

CONSTITUTION: A lid body 6 is moved upward and then a wafer 1 is placed at a chuck 2. The lid body 6 is moved further downward and is allowed to contact an outer cup 4 airtightly. Then, a valve 12b for reducing pressure and discharging air is opened, a pressure-reducing and discharging device 12a is operated, and then a coating space 8 is gradually discharged for reducing pressure and discharging air to a desired pressure-reduced state. Then, a valve 21 for opening and closing the gap between a media environmental space 19 and the coating space 8 of an environment gas generator 16 is opened and then a uniformly concentrated and stable saturation environment gas 13 within the media environment space 19 flows into the coating space 8. Then, a resist nozzle 9 is automatically set to a penetration hole 11 positioned at the center of the lid body 6. Then, a shutter 10 provided at the penetration hole 11 is opened for a specified amount of time and photoresist is dripped toward the wafer 1 from the resist nozzle 9. Then, a motor 3 is allowed to rotate at a specified high speed and the entire surface of the wafer 1 is dispersion-coated with photoresist.



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CLAIMS

(57) [Claim(s)]

[Claim 1] The process which holds the process which arranges a coated object in a container, and the space where the coated object in a container has been arranged in the airtight condition, stops exhaust air after exhausting the inside of it, and holds the inside of said space in the reduced pressure condition of a predetermined pressure, The process which the solvent content gas containing the solvent which constitutes the resist which it is going to apply to said coated object is made to flow in said space, and makes the inside of said space the solvent ambient atmosphere of the homogeneity concentration of atmospheric pressure, The method of application of the resist characterized by providing the process which applies a resist to said coated object in the space made into the solvent ambient atmosphere of this atmospheric pressure.

[Claim 2] The spreading container which applies a resist to a coated object, and the solvent supply container with which the solvent ambient atmosphere space which contains the solvent which constitutes a resist by the saturation state, and is held at an atmospheric-air ambient atmosphere was formed The process connected through the bulb prepared in the middle of piping and piping, The process which arranges a coated object in said spreading container where said bulb is closed, The process which stops exhaust air after holding and exhausting the space where the coated object has been arranged in the airtight condition, and holds the inside of said space in the reduced pressure condition of a predetermined pressure, The process which solvent content gas is made to flow into said spreading container from said solvent supply container which opens said bulb and is held at atmospheric pressure, and makes the inside of said space the solvent ambient atmosphere of the homogeneity concentration of atmospheric pressure, The method of application of the resist characterized by providing the process which applies a resist to said coated object in the space made into the solvent ambient atmosphere of this atmospheric pressure.

[Claim 3] Said solvent supply container is the method of application of the resist according to claim 2 characterized by carrying out bubbling of the solvent which constitutes a resist with inert gas or clean air, and generating solvent content gas.

[Claim 4] The solvent ambient atmosphere space of said solvent supply container is the method of application of the resist according to claim 2 or 3 characterized by being fully larger than the space of said spreading container.

[Claim 5] A coated object is arranged. The configuration space The spreading container which can be held airtightly, An exhaust air means to exhaust said space in the condition of having held airtightly, and a solvent content gas supply means to supply the solvent content gas containing the solvent which constitutes a resist in said tight container, The resist supply nozzle which supplies a resist to the coated object arranged in said space is provided. After exhausting the space of said tight container held in the condition that said coated object has been arranged at the airtight condition with said exhaust air means, stop exhaust air and said space is held in the predetermined reduced pressure condition. The coater of the resist which solvent content gas is made to flow in said space from said solvent gas supply means, makes the inside of said space the solvent ambient atmosphere of the homogeneity concentration of an atmospheric pressure, and is characterized by supplying a resist to said coated object by said resist supply nozzle, and applying in the ambient atmosphere.

[Claim 6] A coated object is arranged. The configuration space The spreading container which can be held airtightly, The solvent supply container with which the solvent ambient atmosphere space which is connected with the tight container with which a coated material is held, and said spreading container through piping and a bulb, contains the solvent which constitutes a resist by the saturation state, and is held at an atmospheric-air ambient atmosphere was formed, An exhaust air means to exhaust the inside of said tight container, and the resist supply nozzle which supplies a resist to the coated object arranged in said space are provided. After exhausting the space of said tight container held at the airtight condition where said coated object has been arranged and a bulb is closed with said exhaust air means, stop exhaust air and it holds in the predetermined reduced pressure condition. Make it bulb open [said] in the condition, and solvent content gas is made to flow

of said space the solvent ambient atmosphere or the homogeneity concentration of an atmospheric pressure, and is characterized by supplying a resist to said spreading object by said resist supply nozzle, and applying in the ambient atmosphere.

[Claim 7] Said solvent supply container is the coater of the resist according to claim 6 characterized by having a bubbling means to carry out bubbling of the solvent which constitutes a resist with inert gas or clean air, and to generate solvent content gas.

[Claim 8] The solvent ambient atmosphere space of said solvent supply container is the coater of the resist according to claim 6 or 7 characterized by being fully larger than the space of said spreading container.

[Claim 9] The coater of a resist given in any 1 term of claim 5 characterized by providing further the shutter which blockades the hole for supplying the resist from said resist supply nozzle to the coated object in said space thru/or claim 8.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[Objects of the Invention]

(Field of the Invention)

This invention relates to the method of application and the coater of a resist.

(Prior art)

There is a process which applies the photoresist film to a wafer uniformly in the manufacture process of a semiconductor device. after a photoresist is dropped at the center section of a wafer, the resist dropped by [quick] starting and coming out and carrying out high-speed rotation of the wafer is distributed over the whole surface on a wafer front face according to a centrifugal force, and the photoresist film is made to form on a wafer front face at this process Moreover, high-speed rotation of a wafer is performed in atmospheric air, and a photoresist is seasoned naturally during rotation. However, as a photoresist distributes the front face of a wafer, the solvents in a photoresist (for example, thinner etc.) evaporate in an ununiformity partially, and since the viscosity of a resist changes partially, thickness unevenness arises in radial [of a wafer]. In order to mitigate such thickness unevenness, the steam of a solvent is generated, a spreading ambient atmosphere is exhausted, the steam of a solvent is attracted, and the equipment which applies in the state of exhaust air is indicated by JP,61-29125,A. Moreover, a solvent solution is put in in a rotation spreading container, and the approach of applying by making a solvent ambient atmosphere is indicated by JP,51-65882,A.

(Object of the Invention)

However, it is required with diameter[of macrostomia]-izing and VLSI-izing of a wafer that a photoresist should be further applied to homogeneity. For this reason, as shown in the above-mentioned official report, generate the solvent steam of a photoresist in a bubbler, operate the exhaust air pump of the spreading cup lower part, introduce a solvent steam in a spreading cup through an airpipe, and the spreading section is made into a solvent steamy ambient atmosphere. Although evaporation of the solvent in a photoresist is controlled and a viscous change of the resist under spreading is suppressed Since the exhaust air pump, the bubbler, etc. are carrying out spreading working actuation, further The flow of an air current arises in a spreading cup by high-speed rotation of a wafer, the concentration of a solvent steam changes with locations strictly, and the solvent in a photoresist evaporates in an ununiformity in each part of a wafer according to the concentration difference of a solvent steam. Since the viscosity of a photoresist changed partially, if small to the thickness of a wafer, although it was, there was a problem said that an uneven part arises. Moreover, after putting in the solvent solution in the spreading container and dropping the photoresist on the wafer, by the approach of shutting a lid, saturating the steam of a solvent and carrying out rotation spreading, for making the inside of a spreading container into a saturation solvent ambient atmosphere completely, long duration was required by closing motion of a lid, and there was a problem to which working efficiency falls very much. Moreover, there was a problem said that an uneven part arises although it is small to the thickness of a wafer in order for the flow of an air current to arise by solvent ambient atmosphere concentration's changing with locations in a spreading container in the solvent ambient atmosphere after a certain amount of solvent evaporates, and carrying out high-speed rotation for spreading of a wafer, and for the solvent ambient atmosphere concentration of a wafer to change with locations strictly and to change partially [the viscosity of a photoresist]. At the process of which especially micro-machining, such as a VLSI, is required, few of this ununiformity has overly had the extraordinary bad influence on dispersion in a detailed pattern completion dimension etc. This invention was made in order to improve the point describing above, and it tends to offer the method of application and the coater of a photoresist which can form the uniform spreading film.

[Elements of the Invention]

(The means for solving a technical problem)

The process which stops exhaust air after this invention holds the space where the coated object in a container has been arranged the 1st in the airtight condition and exhausts the inside of it, and holds the inside of said

technical problem, the process which the solvent content gas containing the solvent which constitutes the resist which it is going to apply to said coated object is made to flow in said space, and makes the inside of said space the solvent ambient atmosphere of the homogeneity concentration of atmospheric pressure, The method of application of the resist characterized by providing the process which applies a resist to said coated object in the space made into the solvent ambient atmosphere of this atmospheric pressure is offered.

The spreading container which applies a resist to the 2nd to a coated object, and the solvent supply container with which the solvent ambient atmosphere space which contains the solvent which constitutes a resist by the saturation state, and is held at an atmospheric-air ambient atmosphere was formed The process connected through the bulb prepared in the middle of piping and piping, The process which arranges a coated object in said spreading container where said bulb is closed, The process which stops exhaust air after holding and exhausting the space where coated object has been arranged in the airtight condition, and holds the inside of said space in the reduced pressure condition of a predetermined pressure, The process which solvent content gas is made to flow into said spreading container from said solvent supply container which opens said bulb and is held at atmospheric pressure, and makes the inside of said space the solvent ambient atmosphere of the homogeneity concentration of atmospheric pressure, The method of application of the resist characterized by providing the process which applies a resist to said coated object in the space made into the solvent ambient atmosphere of this atmospheric pressure is offered.

In the 2nd approach of the above, said solvent supply container provides the 3rd with the method of application of the resist characterized by carrying out bubbling of the solvent which constitutes a resist with inert gas or clean air, and generating solvent content gas.

In the 2nd or 3rd approach of the above, the solvent ambient atmosphere space of said solvent supply container provides the 4th with the method of application of the resist characterized by being fully larger than the space of said spreading container.

A coated object is arranged the 5th. The configuration space The spreading container which can be held airtightly, An exhaust air means to exhaust said space in the condition of having held airtightly A solvent content gas supply means to supply the solvent content gas containing the solvent which constitutes a resist in said tight container, The resist supply nozzle which supplies a resist to the coated object arranged in said space is provided. After exhausting the space of said tight container held in the condition that said coated object has been arranged at the airtight condition with said exhaust air means, stop exhaust air and said space is held in the predetermined reduced pressure condition. The coater of the resist which solvent content gas is made to flow in said space from said solvent gas supply means, makes the inside of said space the solvent ambient atmosphere of the homogeneity concentration of an atmospheric pressure, and is characterized by supplying a resist to said coated object by said resist supply nozzle, and applying in the ambient atmosphere is offered.

A coated object is arranged the 6th. The configuration space The spreading container which can be held airtightly, Tight container with which a coated material is held The solvent supply container with which the solvent ambient atmosphere space which is connected with said spreading container through piping and a bulb, contains the solvent which constitutes a resist by the saturation state, and is held at an atmospheric-air ambient atmosphere was formed, An exhaust air means to exhaust the inside of said tight container The resist supply nozzle which supplies a resist to the coated object arranged in said space is provided. After exhausting the space of said tight container held at the airtight condition where said coated object has been arranged and a bulb is closed with said exhaust air means, stop exhaust air and it holds in the predetermined reduced pressure condition. Make it bulb open [said] in the condition, and solvent content gas is made to flow in said spreading container from said solvent supply container. The coater of the resist which makes the inside of said space the solvent ambient atmosphere of the homogeneity concentration of an atmospheric pressure, and is characterized by supplying a resist to said coated object by said resist supply nozzle, and applying in the ambient atmosphere.

In the 6th equipment of the above, said solvent supply container provides the 7th with the coater of the resist characterized by having a bubbling means to carry out bubbling of the solvent which constitutes a resist with inert gas or clean air, and to generate solvent content gas.

In the 6th or 7th equipment of the above, the solvent ambient atmosphere space of said solvent supply container provides the 8th with the coater of the resist characterized by being fully larger than the space of said spreading container.

The coater of the resist characterized by providing further the shutter which blockades the hole for 9th supplying the resist from said resist supply nozzle to the coated object in said space in the equipment of one of the above is offered.

(Operation)

In this invention, hold the space where the coated object in a container has been arranged in the airtight

pressure condition of a predetermined pressure, the solvent content gas containing the solvent which constitutes a resist from the condition is made to flow in said space, and the inside of said space is made into the solvent ambient atmosphere of the homogeneity concentration of atmospheric pressure. Thus, since spreading space is the solvent concentration of homogeneity, and is moreover an atmospheric pressure and there is no turbulence of air currents, such as an atmospheric inflow, the uniform spreading film can be formed in the small amount of resists by performing resist spreading processing in it.

The solvent supply container with which the solvent ambient atmosphere space which contains the solvent which constitutes a resist especially by the saturation state, and is held at an atmospheric-air ambient atmosphere was formed. It freezes in a spreading container through the bulb prepared in the middle of piping and piping. For example, in making a solvent flow into the spreading space under reduced pressure of the solvent content gas which carries out bubbling and occurs with inert gas or clean air. Since a saturation solvent controlled atmosphere with uniform concentration will flow into spreading space in the state of the atmospheric pressure formed beforehand, the spreading space which is homogeneity concentration much more and does not have turbulence can be formed, and the much more uniform spreading film can be formed.

In this case, solvent ambient atmosphere space can be made into the always stabilized saturation solvent ambient atmosphere by making solvent ambient atmosphere space of a solvent supply container larger enough than spreading space.

Furthermore, in case it holds under reduced pressure of spreading space and a solvent ambient atmosphere is further formed into it by preparing the shutter which blockades the hole for supplying the resist from a resist supply nozzle to the coated object in spreading space, a shutter is closed, the inside of it is made into a closed space, a shutter is opened only in the case of spreading and it can perform spreading processing.

(Example)

The method of application of this invention resist is explained with reference to a drawing below per [which was applied to the photoresist coater to a semi-conductor wafer top] example. The chuck to which the rotation spreading section (0) of spinner equipment carries out installation adsorption of the wafer (1) as shown in Fig. 1 (2). The motor to which high speed rotation, for example, 5000-10000 revolution per minute, of this chuck (2) is carried out (3). In order to use as a full seal chamber the inside of the cup section (4), i.e., an outside cup, divided into two relative up and down since it was movable, a bottom cup (5), and a cup, the upper part of an outside cup (4) consists of wrap lids (6) airtightly. The inside wall surface of an outside cup (4) is carrying out the configuration which extended the vertical side of the character of "KO" in order to stop the rebound phenomenon of the photoresist which dispersed. Moreover, the outside cup (4) has hermetic seal structure by the bottom cup (5), O ring, etc. Moreover, a bottom cup (5) is perpendicularly prepared free [migration] by the driving gear which is not illustrated, and can prepare a gap (7) from the airtight condition of a cup (4) outside Fig. 1 between the outside cup (4) which moved caudad, for example and was shown in Fig. 1-a, and a bottom cup (5). It has structure which can perform discharge of the photoresist and rear-face rinse which dispersed by piping which is not illustrated through this gap (7) in exhaust air of the controlled atmosphere after spreading etc., and an outside cup (4), a side rinse, a cup penetrant remover, etc. Moreover, the lid (6) has an outside cup (4) and hermetic seal structure by O ring etc. like the bottom cup of a **** (5). Thus, spreading space (8) consists of space which consisted of an outside cup (4), a bottom cup (5), and a lid (6). And the through tube (11) which prepared the shutter (10) in the location corresponding to the core of the wafer (1) of this lid (6) so that the alignment of the resist nozzle (9) which applies photoresist liquid could be carried out free [insertion] and the hermetic seal of it could be carried out is prepared. The evacuation hole for furthermore making the above-mentioned space (8) the above-mentioned lid (6) at predetermined reduced pressure, for example, 700 - 600mmHg, (12). The controlled atmosphere installation hole which introduces the saturation state solvent controlled atmosphere (13) of the solvent, for example, thinner etc., which constitutes the photoresist applied to the above-mentioned spreading space (8) on a wafer (1) using reduced pressure of the above-mentioned spreading space (8), and 80% or more of solvent ambient atmosphere partial pressures (14). In order to control the gas concentration of the solvent controlled atmosphere (13) in a purge or spreading space (8) for the inside of spreading space (8), the gas installation hole (15) which introduces inert gas, for example, nitrogen gas, or clean air is prepared. And the above-mentioned evacuation hole (12) is connected to evacuation equipment (12a) by piping, and the bulb (12b) which opens and closes piping passage is prepared in the middle of piping. Similarly, the gas installation hole (15) is connected through the bulb (15b) which opens and closes piping passage by piping to the source of supply (15a) of inert gas, for example, N2 gas, or clean air. And it changes that migration to a perpendicular direction is free with the driving gear which does not illustrate the above-mentioned lid (6). An outside cup (4) and a lid (6) open by rise of the above-mentioned lid (6), and loading/unload of a wafer (1) are made possible to the chuck (2). The atmosphere gas generator (16) which, on the other hand, generates a

atmosphere gas generator (10) forms a well closed container (17), and the solvent (18), for example, the same solvent as cello SORUBUSU acetate, which constitutes the photoresist (trade name), OFPR-800 [for example,], to apply is contained in this container (17). And the solvent ambient atmosphere space (19) which a solvent evaporates in the upper part of a solvent (18), and forms a saturation solvent controlled atmosphere is prepared. This space (19) changes with sufficiently big space compared with the above-mentioned spreading space (8). That is, it is made the relation of solvent ambient atmosphere space (19) >> spreading space (8), and the solvent controlled atmosphere (13) of space (19) makes inhalation easy through the bulb (21) to space (8). And the bulb (21) which this solvent ambient atmosphere space (19) and said spreading space (8) are connected through the solvent controlled atmosphere installation hole (14) of a lid (6) by piping (20) which introduces the above-mentioned solvent controlled atmosphere into spreading space (8), and opens and closes piping passage in the middle of piping (20) is prepared. Moreover, a bubbler (22) is prepared in a well-closed container (17) so that it may be located under the oil level of a solvent (18), and it is prepared in this bubbler so that the clean air or inert gas with which a decompressed part of the part by which the solvent controlled atmosphere (13) of solvent ambient atmosphere space (19) flowed into spreading space (8) is compensated may be supplied. Therefore, since it has the relation of solvent ambient atmosphere space (19) >> spreading space (8), solvent ambient atmosphere space (19) can maintain the condition of having been filled with the always stabilized saturation solvent controlled atmosphere.

Next, actuation is explained.

The clean air of solvent ambient atmosphere space (19) or inert gas, for example, N₂ gas, is first made into the saturation solvent controlled atmosphere of the atmospheric pressure of 80% or more of solvent ambient atmosphere partial pressures by natural evaporation of a solvent (18) etc. moreover, when a solvent is replaced when a solvent (18) is newly put into a solvent atmosphere gas generator (16) or. Close the bulb which the bubbler (22) of an atmosphere gas generator (16) does not illustrate, and solvent ambient atmosphere space (19) is evacuated via piping which for example, evacuation equipment (12a) is operated, and does not illustrate it. Open the bulb which a bubbler (22) does not illustrate after this, operate a bubbler (22), clean air or inert gas is made to blow off from a bubbler (22), and the saturation solvent controlled atmosphere of atmospheric pressure may be created.

Next, it moves up with the driving gear which does not illustrate a lid (6), and a wafer (1) is laid to a chuck (2) by the robot equipment or manual actuation which is not illustrated. It moves caudad with the driving gear which does not illustrate a lid (6), and it contacts so that it may change airtightly with an outside cup (4). this -- now, the cup (5) has contacted so that it may grow into an outside cup (4) airtightly. Moreover, a bulb and shutters, such as a shutter (10) of the through tube (11) which trickles a photoresist into a wafer (1) from the bulb (15b) linked to the inert gas or the clean air source of supply (15a) linked to the above-mentioned lid (6) and a resist nozzle (9), and a bulb (21) for the controlled atmosphere (31) installation from an atmosphere gas generator, are made into the closed state. Then, the bulb for evacuation (12b) is opened, evacuation equipment (12a) is operated, spreading space (8) is exhausted gradually, and it evacuates in the desired reduced pressure condition, for example, 700 – 600mmHg. The bulb (12b) of evacuation Rhine is closed in the place which reached the desired pressure. That is, spreading space (8) serves as a sealed cabin maintained at the desired reduced pressure condition. Next, the saturation solvent controlled atmosphere (13) by which the uniform concentration in solvent ambient atmosphere space (19) was stabilized so that the bulb (21) which opens and closes between the solvent ambient atmosphere space (19) of an atmosphere gas generator (16) and spreading space (8) might be opened and a part for the differential pressure to the reduced pressure status value of spreading space (8), for example, the atmospheric pressure of 700 – 600mmHg, might be filled up flows in in spreading space (8). Moreover, the clean air or inert gas of an amount corresponding to the solvent controlled atmosphere (13) with which the above flowed in is introduced from a bubbler (22). At this time, since there is relation of solvent ambient atmosphere space (19) >> spreading space (8), the homogeneity of solvent controlled atmosphere (13) concentration is not disturbed with the quantity of gas introduced from the bubbler (22). Therefore, the inside of spreading space (8) is uniformly filled with a uniform concentration saturation solvent controlled atmosphere to all the corners, and will be in an atmospheric pressure condition. The bulb (21) of controlled atmosphere installation Rhine is closed here. Next, it sets automatically to the through tube for Regis spreading (11) located in the center of a lid (6) according to the robot device in which a resist nozzle (9) is not illustrated etc. And only predetermined time amount opens the shutter (10) prepared in the above-mentioned through tube (11), and a photoresist is turned and dropped at a wafer (1) from a resist nozzle (9). The resist nozzle after dropping (9) returns to an outside [location / of a wafer (1) / upper part] position, and stands by at the next photoresist dropping term. Therefore, after a photoresist is dropped, a shutter (10) will be in a closed state. And a high speed is made to rotate a motor (3) at a predetermined rate, for example, 7000 – 10000 revolution per minute, and

speed rotation at first, and may be switched to high-speed rotation the middle. Since the inside of spreading space (8) is filled with the saturation solvent controlled atmosphere (13) of 80% or more of uniform concentration, for example, a solvent ambient atmosphere partial pressure, at this time, Even if the flow of the air current by rotation of a wafer (1) etc. arises, are uninfluential to solvent controlled atmosphere concentration in any way. Since it evaporates in homogeneity even if there is very little evaporation of the solvent in the photoresist under distribution and it evaporates, most viscous change of a photoresist cannot be found, and the uniform spreading film is formed in a wafer (1). Moreover, since the amount of the dropped photoresist does not almost have the viscous change with very little evaporation of the solvent of a photoresist, either, the mileage of a photoresist is also good, and it is spreading ***** in the amount of resists smaller than before. Moreover, in the above-mentioned example, after the photoresist was dropped, high-speed rotation of the wafer (1) was carried out by the motor (3), but a photoresist may be dropped after carrying out high-speed rotation of the wafer (1) by the motor (3) previously. Next, in order to dry the photoresist applied to homogeneity on the wafer (1) side, the bulb (15b) of inert gas or clean air source-of-supply (15a) Rhine is opened. Evacuation equipment (12a) is used, the solvent controlled atmosphere (13) in spreading space (8) is exhausted, it permutes by inert gas or clean air, and the photoresist film applied to homogeneity is dried at the same time it introduces inert gas or clean air in spreading space (8). Or it may be made to go up with the driving gear which does not illustrate a lid (6), direct spreading space (8) may be wide opened to atmospheric-air space, and the photoresist film applied to homogeneity may be dried. And rotation of a motor (3) is suspended after photoresist film desiccation of a wafer (1). Next, it moves to a top and down respectively with the driving gear which does not illustrate a lid (6) and a bottom cup (5). And it passes along the gap (7) of an outside cup (4) and a bottom cup (5), and discharges through piping which illustrates neither the photoresist which dispersed in the outside cup (4) and collected on the lower part of an outside cup (4), nor Myst. Moreover, the residual solvent controlled atmosphere (13) in spreading space (8) etc. is exhausted. And the wafer (1) laid on the chuck (2) by the robot equipment or manual actuation which is not illustrated is taken out, and spreading actuation is completed.

The structure (the 2b Fig.) where the structure (the 2a Fig.) which makes a tight container cup one apparatus and moves a lid (6) up and down, or an outside cup (4) moves up and down as shown in Fig. 2 although the outside cup (4), the bottom cup (5), and the lid (6) constituted the tight container from the above-mentioned example, and a lid also moves up and down is sufficient. Moreover, the controlled atmosphere temperature of an atmosphere gas generator and the temperature gradient with the spreading space (8) of the spreading section (0) may give the function in which few things control the spreading section, an atmosphere gas generator, and the temperature of piping in the meantime desirably. Moreover, although the gas of the amount which prepared the bubbler (22) in the atmosphere gas generator (16), and flowed into spreading space (8) was compensated with the above-mentioned example, piping etc. may be prepared in solvent ambient atmosphere space (19), and direct inert gas and clean air may be filled up.

Since according to this example the saturation solvent controlled atmosphere of the uniform concentration beforehand prepared where exhaust air is stopped is made to flow and photoresist spreading is performed in this saturation solvent gas ambient atmosphere once evacuating the inside of the tight container which forms the spreading section to the pressure value which was able to be defined beforehand, compared with the former, the uniform spreading film can be formed in a wafer front face in the amount of photoresists of a small amount. (Effect of the invention)

According to this invention, after evacuating the spreading section formed with the tight container, the effectiveness which forms the uniform spreading film is acquired by being [controlled atmosphere / of uniform concentration / solvent] full of homogeneity, and carrying out rotation spreading, where exhaust air is stopped.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

An explanatory view of operation for the block diagram of the coater used in order that Fig. 1 may explain one example of this invention approach, and Fig. 1-a to explain actuation of 1st [**] Fig. equipment, and Figs. 2 are other example explanatory views of the tight container of 1st [**] Fig. coater.

4 An outside cup, 5 .. Bottom cup

6 A lid, 8 .. Spreading space

12 An evacuation hole, 14 .. Controlled atmosphere installation hole

19 Solvent ambient atmosphere space

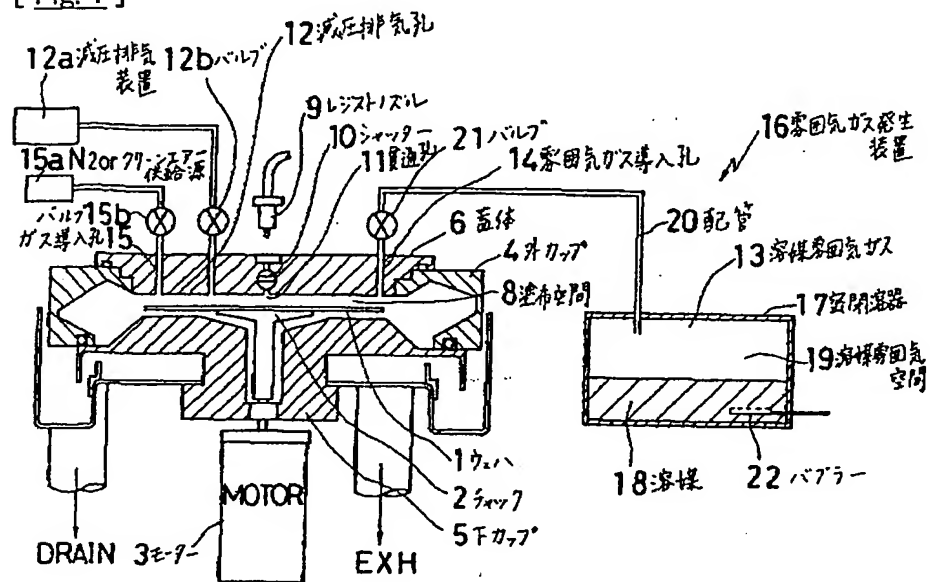
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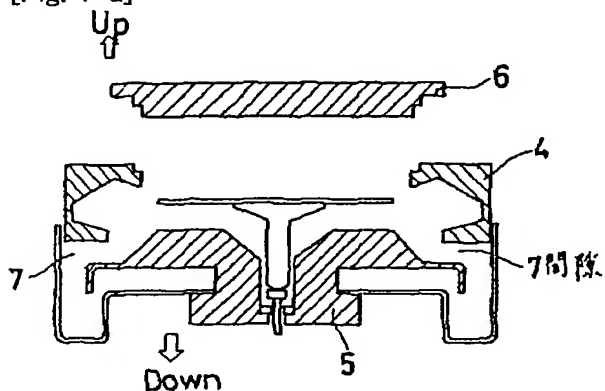
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DRAWINGS

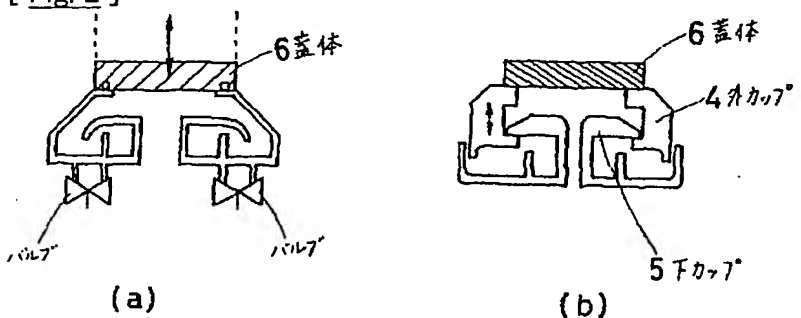
[Fig. 1]



[Fig. 1-a]



[Fig. 2]



[Translation done.]

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⑱ 発 明 者 牛 島 満 東京都新宿区西新宿1丁目26番2号 東京エレクトロン株式会社内

⑲ 出 願 人 東京エレクトロン株式 東京都新宿区西新宿1丁目26番2号
会社

明 細 書

1. 発明の名称

レジストの塗布方法

2. 特許請求の範囲

気密容器に被塗布物を設け、上記気密容器内を予め定められた圧力値に減圧排気した後、排気を停止した状態で前記レジストを構成する溶媒雰囲気ガスを前記気密容器内に投入させ、前記溶媒雰囲気ガスで置換した後、この溶媒雰囲気ガス中でレジストの塗布を行う事の特徴とするレジストの塗布方法。

3. 発明の詳細な説明

(発明の目的)

(産業上の利用分野)

本発明はレジストの塗布方法に関する。

(従来の技術)

半導体装置の製造過程に於てウエハにフォトリソist膜を一緒に塗布する工程がある。この工程ではウエハの中央部にフォトリソistを滴下した後、速い立ち上がりでウエハを高速回転すること

により滴下したレジストを遠心力によってウエハ表面上に全面にわたって分散させ、ウエハ表面上にフォトリソist膜を形成させるものである。またウエハの高速回転は大気中で行い、フォトリソistは回転中に自然乾燥する。しかしながら、フォトリソistがウエハの表面を分散する途中で、フォトリソist中の例えばシンナー等の溶媒が部分的に不均一に蒸発してしまい、レジストの粘性が部分的に変化するためウエハの半径方向に厚さむらが生じる。この様な厚さむらを軽減するために、溶媒の蒸気を発生させ、塗布雰囲気排気を排気して溶媒の蒸気を吸引し、排気状態で塗布を行う装置が特開昭61-29125号公報に開示されている。また、回転塗布容器内に溶媒溶液を入れ、溶媒雰囲気を作り塗布を行う方法が特開昭51-65882号公報に開示されている。

(発明が解決しようとする課題)

しかしながら、ウエハの大口径化と超LSI化に伴い、よりいっそう均一にフォトリソistを塗布することが要求されている。このため上記公報

に示されるようにフォトレジストの溶媒蒸気をバブラで発生させ、塗布カップ下部の排気ポンプを作動させ、送気管を介し塗布カップ内に溶媒蒸気を導入し塗布部を溶媒蒸気雰囲気にして、フォトレジスト中の溶媒の蒸発を抑制し、塗布中のレジストの粘性変化を抑えているが、排気ポンプ、バブラ等が塗布動作中動作しているため、またさらに、ウェハの高速回転により塗布カップ内に気流の流れが生じ、厳密には溶媒蒸気の濃度が場所により異なり溶媒蒸気の濃度差によりフォトレジスト中の溶媒がウェハの各部において不均一に蒸発し、フォトレジストの粘性が部分的に変化するためウェハの膜厚にわずかではあるが不均一な部分が生じると言う問題があった。また、溶媒溶液を塗布容器内に入れ、フォトレジストをウェハ上に滴下した後、蓋を閉め溶媒の蒸気を飽和させ回転塗布する方法では、蓋の開閉により塗布容器内を完全に飽和溶媒雰囲気にするには長時間を要し、作業効率が非常に低下する問題があった。また、ある程度の溶媒が蒸発した後の溶媒雰囲気では塗

布容器内の場所により、溶媒雰囲気濃度が異なり、ウェハを塗布のため高速回転させることにより、気流の流れが生じ、ウェハの溶媒雰囲気濃度が厳密には場所により異なってしまい、フォトレジストの粘性が部分的に変化するためウェハの膜厚に僅かではあるが不均一な部分が生じると言う問題があった。特に超LSI等の超微細加工を要求される工程ではこの僅かな不均一が超微細パターン完成寸法のばらつき等に非常な悪影響を及ぼしている。この発明は上記点を改善するためになされたもので、均一な塗布膜を形成できるフォトレジストの塗布方法を提供しようとするものである。

(発明の構成)

(課題を解決するための手段)

この発明は気密容器に被塗布物を設け、上記気密容器内を予め定められた圧力値に減圧排気した後、排気を停止した状態で前記レジストを構成する溶媒雰囲気ガスを前記気密容器内に流入させ、前記溶媒雰囲気ガスで置換した後、この溶媒雰囲気ガス中でレジストの塗布を行う事の特徴とする

レジストの塗布方法を得るものである。

(作用)

本発明によれば、均一な濃度の溶媒ガス雰囲気中で、回転塗布することにより均一な塗布膜を形成できる。

(実施例)

以下本発明レジストの塗布方法を半導体ウェハ上へのフォトレジスト塗布装置に適用した一実施例につき図面を参照して説明する。第1図に示すようにスピナー装置の回転塗布部(0)はウェハ(1)を載置吸着するチャック(2)と、このチャック(2)を高速回転例えば5000~10000回転/分させるモータ(3)と、相対的に上下に移動可能とするため2分割したカップ部即ち外カップ(4)と下カップ(5)及びカップ内を完全密封チャンバーとするため外カップ(4)の上部を気密に覆う蓋体(6)とから構成されている。外カップ(4)の内側壁面は飛散したフォトレジストの跳ね返りを抑えるため"J"の字の上下辺を広げた形状をしている。また外カップ(4)

は下カップ(5)とOリング等による気密封止構造となっている。また、下カップ(5)は図示しない駆動装置により垂直方向に移動自在に設けられ、第1図の外カップ(4)の気密状態から、例えば下方に移動し第1-a図に示した外カップ(4)と下カップ(5)との間に間隙(7)を設けることができる。この間隙(7)を通り図示しない配管により塗布後の雰囲気ガス等の排気及び外カップ(4)に飛散したフォトレジストや裏面リンスやサイドリンスやカップ洗浄液等の排出ができる構造となっている。また、蓋体(6)も、上述の下カップ(5)と同様に、外カップ(4)とOリング等による気密封止構造となっている。このように外カップ(4)と下カップ(5)と蓋体(6)で構成された空間で塗布空間(8)を構成している。そして、この蓋体(6)のウェハ(1)の中心に対応する位置に、フォトレジスト液を塗布するレジストノズル(9)を挿入自在に位置合わせでき、かつ気密封止できるが如くシャッター(10)を設けた貫通孔(11)がもうけら

れている。さらに上記蓋体(6)には上記空間(8)を所定の減圧例えば700~600 mmHgにするための減圧排気孔(12)と、上記塗布空間(8)の減圧を利用して、上記塗布空間(8)へウエハ(1)上に塗布するフォトレジストを構成している溶媒例えばシンナー等の例えば溶媒雰囲気分圧80%以上の飽和状態溶媒雰囲気ガス(13)を導入する雰囲気ガス導入孔(14)と、塗布空間(8)内をバージまたは塗布空間(8)内の溶媒雰囲気ガス(13)のガス濃度を制御するために不活性ガス例えば窒素ガスあるいはクリーンエアーを導入するガス導入孔(15)が設けられている。そして、上記減圧排気孔(12)は配管により減圧排気装置(12a)に接続され、配管途中には配管流路を開閉するバルブ(12b)が設けられている。同様に、ガス導入孔(15)も配管により不活性ガス例えばN₂ガスまたはクリーンエアーの供給源(15a)に配管流路を開閉するバルブ(15b)を介して接続されている。そして上記蓋体(6)も図示しない駆動装置によ

り垂直方向に移動自在と成っている。上記蓋体(6)の上昇により外カップ(4)と蓋体(6)とが閉きチャック(2)へウエハ(1)のロード／アンロードを可能としている。一方、上記塗布部(0)とは別に溶剤雰囲気ガス(13)を発生させる雰囲気ガス発生装置(16)が設けられている。この雰囲気ガス発生装置(16)は密閉容器(17)を形成し、この容器(17)内には塗布するフォトレジスト例えばOPPR-800(商品名)を構成している溶媒例えばセロソルブアセテートと同じ溶媒(18)が収納されている。そして、溶媒(18)の上部には溶媒が蒸発し飽和溶媒雰囲気ガスを形成する溶媒雰囲気空間(19)が設けられている。この空間(19)は上記塗布空間(8)に比べ十分大きな空間と成っている。即ち、溶媒雰囲気空間(19) >> 塗布空間(8)の関係にし、空間(19)の溶媒雰囲気ガス(13)が空間(8)へバルブ(21)を介して吸入を容易にしている。そして、この溶媒雰囲気空間(19)と前記塗布空間(8)とは上記溶

媒雰囲気ガスを塗布空間(8)に導入する配管(20)により蓋体(6)の溶媒雰囲気ガス導入孔(14)を介し接続され、また配管(20)の途中には配管流路を開閉するバルブ(21)が設けられている。また、密閉容器(17)には溶剤(18)の液面下に位置する如くバブラー(22)が設けられ、このバブラーへは溶剤雰囲気空間(19)の溶媒雰囲気ガス(13)が塗布空間(8)へ流入した分の減圧分を補うだけのクリーンエアーまたは不活性ガスが補給される如く設けられている。従って、溶媒雰囲気空間(19) >> 塗布空間(8)の関係にあるため、溶媒雰囲気空間(19)は常に安定した飽和溶剤雰囲気ガスで満たされた状態を維持できる。

次に動作について説明する。

まず溶媒雰囲気空間(19)のクリーンエアーまたは不活性ガス例えばN₂ガスを溶媒(18)の自然蒸発等により例えば溶媒雰囲気分圧80%以上の大気圧の飽和溶媒雰囲気ガスにする。また、溶媒雰囲気ガス発生装置(16)に溶媒(18)

を新たに入れた場合または溶媒を入れ換えた時には、雰囲気ガス発生装置(16)のバブラー(22)の図示しないバルブを開じ溶媒雰囲気空間(19)を例えば減圧排気装置(12a)を動作させ図示しない配管を経由して減圧排気し、この後バブラー(22)の図示しないバルブを開きバブラー(22)を動作させクリーンエアー又は不活性ガスをバブラー(22)から噴出させ、大気圧の飽和溶媒雰囲気ガスを作成しても良い。

次に、蓋体(6)を図示しない駆動装置により上方に移動し、図示しないロボット装置またはマニュアル操作によりウエハ(1)をチャック(2)へ搬送する。蓋体(6)を図示しない駆動装置により下方に移動し、外カップ(4)と気密に成る如く当接する。この時下カップ(5)は外カップ(4)に気密に成る如く当接している。また、上記蓋体(6)に接続している不活性ガスまたはクリーンエアー供給源(15a)に接続しているバルブ(15b)と、レジストノズル(9)からフォトレジストをウエハ(1)へ滴下する貫通孔(

11)のシャッター(10)及び雰囲気ガス発生装置からの雰囲気ガス(13)導入用のバルブ(21)等のバルブ及びシャッターは閉状態にしておく。そこで、減圧排気用のバルブ(12b)を開き減圧排気装置(12a)を動作し、塗布空間(8)を徐々に排気し所望の減圧状態例えば700~600mmHgに減圧排気する。所望の圧力に到達したところで減圧排気ラインのバルブ(12b)を閉じる。即ち塗布空間(8)は所望の減圧状態に保たれた気密室となる。次に雰囲気ガス発生装置(16)の溶媒雰囲気空間(19)と塗布空間(8)との間を開閉するバルブ(21)を開き塗布空間(8)の減圧状態値、例えば700~600mmHgの大気圧に対しての圧力差を補充するが如く溶媒雰囲気空間(19)内の均一な濃度の安定した飽和溶媒雰囲気ガス(13)が塗布空間(8)内に流れ込む。また、上記の流れ込んだ溶媒雰囲気ガス(13)に対応する量のクリーンエアーまたは不活性ガスがバブラー(22)から導入される。この時、溶媒雰囲気空間(19)

>>塗布空間(8)の関係があるためバブラー(22)から導入された気体量で溶媒雰囲気ガス(13)濃度の均一性が乱されることはない。従って、塗布空間(8)内は均一な濃度の飽和溶媒雰囲気ガスで隔々まで一様に満たされかつ大気圧状態となる。ここで雰囲気ガス導入ラインのバルブ(21)を閉じる。次にレジストノズル(9)を図示しないロボット機構等により蓋体(6)の中央に位置するレジスト塗布用の貫通孔(11)に自動的にセッティングする。そして、上記貫通孔(11)に設けられたシャッター(10)を所定の時間だけ開き、レジストノズル(9)よりフォトレジストをウェハ(1)へ向け滴下する。滴下後レジストノズル(9)はウェハ(1)の上方位置より外側所定の位置に戻り次のフォトレジスト滴下期まで待機する。従って、フォトレジストを滴下した後はシャッター(10)は閉状態となる。そして、モータ(3)を所定の速度例えば7000~10000回転/分で高速に回転させ、フォトレジストをウェハ(1)全面に分散塗布する。

このスピニングコートは最初低速回転し、途中高速回転に切り換えてもよい。この時、塗布空間(8)内は均一な濃度の例えば溶媒雰囲気分圧80%以上の飽和溶媒雰囲気ガス(13)で充されているため、ウェハ(1)の回転による気流の流れ等が生じても、何等溶媒雰囲気ガス濃度に影響は無く、分散中のフォトレジスト内の溶媒の蒸発は非常に少なく、また蒸発するにしても均一に蒸発するためフォトレジストの粘性の変化はほとんど無く、ウェハ(1)には均一な塗布膜が形成される。また滴下するフォトレジストの量も、フォトレジストの溶媒の蒸発が非常に少なく粘性の変化がほとんどないためフォトレジストののびも良く、従来よりも少ないレジスト量で塗布出来る。また、上記例では、フォトレジストを滴下した後、ウェハ(1)をモータ(3)により高速回転したが、先にモータ(3)によりウェハ(1)を高速回転した後、フォトレジストを滴下しても良い。次に、ウェハ(1)面上に均一に塗布されたフォトレジストを乾燥させるため不活性ガスまたはクリーン

エアー供給源(15a)ラインのバルブ(15b)を開き、不活性ガスまたはクリーンエアーを塗布空間(8)内に導入すると同時に、減圧排気装置(12a)を働かせ塗布空間(8)内の溶媒雰囲気ガス(13)を排気し、不活性ガスまたはクリーンエアーに置換し、均一に塗布されたフォトレジスト膜の乾燥を行う。あるいは、蓋体(6)を図示しない駆動装置により上昇させ、直接塗布空間(8)を大気空間に開放し、均一に塗布されたフォトレジスト膜の乾燥をしても良い。そして、ウェハ(1)のフォトレジスト膜乾燥後、モータ(3)の回転を停止する。次に、蓋体(6)及び下カップ(5)を図示しない駆動装置により各々上及び下方向に移動する。そして外カップ(4)と下カップ(5)との間隙(7)を通り、外カップ(4)に飛散し外カップ(4)の下部に溜ったフォトレジストやミスト等を図示しない配管を介して排出する。また、塗布空間(8)内の残留溶媒雰囲気ガス(13)等の排気を行う。そして、図示しないロボット装置またはマニュアル操作に

よりチャック(2)上に載置されたウエハ(1)を取り出し塗布操作が終了する。

上記実施例では、気密容器を外カップ(4)と下カップ(5)及び蓋体(6)で構成したが第2図に示すように気密容器をカップ一体型にし蓋体(6)を上下動する構造(第2a図)あるいは外カップ(4)が上下動し、蓋体も上下動する構造(第2b図)でも良い。また雰囲気ガス発生装置の雰囲気ガス温度と塗布部(8)の塗布空間(8)との温度差は少ない事が望ましく塗布部及び雰囲気ガス発生装置及びこの間の配管の温度をコントロールする機能を持たせてもよい。また、上記実施例では雰囲気ガス発生装置(16)にバブラー(22)を設け、塗布空間(8)へ流れ込んだ量の気体を捕っていたが、溶媒雰囲気空間(19)へ配管等を設け、直接不活性ガスやクリーンエアを補充してもよい。

本実施例によれば、塗布部を形成する気密容器内を予め定められた圧力値に一度減圧排気した後、排気を停止した状態で予め用意した均一な濃度の

飽和溶媒雰囲気ガスを流入させ、この飽和溶媒ガス雰囲気中でフォトリソ塗布を行うため、従来に比べ少量のフォトリソ塗布で均一な塗布膜をウエハ表面に形成する事ができる。

(発明の効果)

本発明によれば、気密容器で形成された塗布部を減圧排気した後、排気を停止した状態で均一な濃度の溶媒雰囲気ガスを均一に充填し回転塗布することにより、均一な塗布膜を形成する効果が得られる。

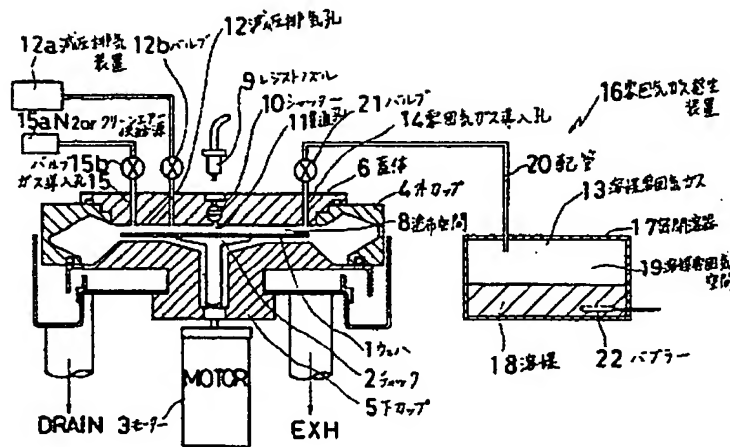
4. 図面の簡単な説明

第1図は塗布装置の構成図、第2図は第1図塗布装置の気密容器の他の実施例説明図である。

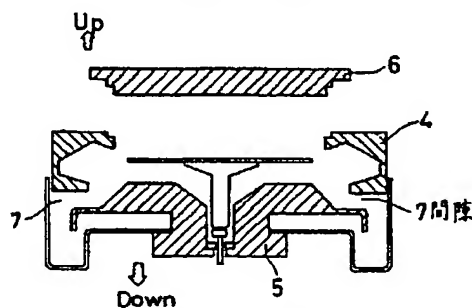
- | | |
|---------------|----------------|
| 4. . 外カップ | 5. . 下カップ |
| 6. . 蓋体 | 8. . 塗布空間 |
| 12. . 減圧排気孔 | 14. . 雰囲気ガス導入孔 |
| 19. . 溶媒雰囲気空間 | |

特許出願人

東京エレクトロン株式会社



第 1 図



第 1-a 図

手続補正書(方式)

平成 年 月 日

1.3.15



特許庁長官殿

1. 事件の表示

特願昭63-275767号

2. 発明の名称

レジストの塗布方法

3. 補正をする者

事件との関係 特許出願人

住所 〒163 東京都新宿区西新宿1丁目26番2号

名称 東京エレクトロン株式会社

代表者 小 高 敏 夫



4. 補正命令の日付

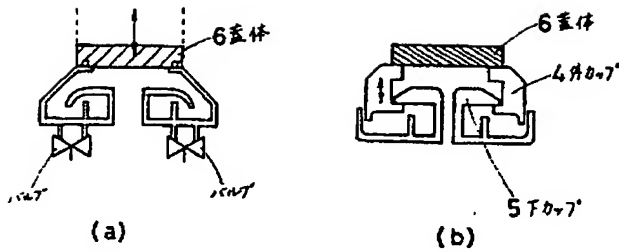
平成 1 年 3 月 7 日(発送日)

5. 補正の対象

明細書の図面の簡単な説明の欄

6. 補正の内容

方式 査 竹内



第 2 図

(1)明細書の第16頁第12行目の「第1図は塗布装置の構成図、第2図は・・・」を「第1図は本発明方法の一実施例を説明するために用いられる塗布装置の構成図、第1-a図は第1図装置の動作を説明するための動作説明図、第2図は・・・」と訂正する。